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MEASURING THE DYNAMICS OF STRUCTURAL CHANGES IN BIOLOGICAL MACROMOLECULES FROM LIGHT SCATTERING DATA

Prepared By: Adriel D. Johnson, Ph.D.

Academic Rank: Assistant Professor

Institution and Department: University of Alabama in Huntsville
Department of Biological Sciences

MSFC Colleague: David A. Noever, Ph.D.

NASA/MSFC:

Office: Space Sciences Laboratory
Division: Microgravity Sciences and Applications
Branch: Biophysics

Examining techniques to study the dynamics of structural changes in various molecules has been an on going goal of the space program. How these phenomena occur in biological systems would be necessary for life to remain functional in the space environment. Hierarchy of biological organization is attained when cells join together small organic molecules to form larger and more complex molecules. Characterizing the architecture of a particular macromolecule helps determine how that molecule works in the living cell and is fundamental to the diversity of life. Understanding this arrangement involves the correlation of the structure of macromolecules with their functions.

A light scattering photometer was developed for detecting continuous measurement of the angular spectrum of light scattered by dynamically changing systems (2). The analysis of light scattered by biological macromolecules can be used to determine concentration, size, shape, molecular weight, and structural changes of cells, such as erythrocytes (2). Some light scattering photometers can collect and store 12Ø angular scattering spectra per minute, with an angular resolution of Ø.2 degrees which can be displayed with computer graphics (2). The light scattering photometer functions to produce and detect scattered light, determines scatter angles, and collects, stores, analyzes data.

The summer project involved the theoretical development of a system which could be used to measure the dynamic changes of erythrocytes during ground based studies and under conditions of low-gravity on the KC-135 research plane. Previous ground laboratory studies and space shuttle studies have shown differences in the kinetics and morphological aggregation of erythrocytes from patients with specific pathophysiological conditions (1). The erythrocyte aggregates formed in space from these patients showed a rouleaux formation while the same samples showed severe clumping and sludging on the ground (1). Erythrocytes from normal individuals showed a rouleaux formation (3) on the ground while having a random swarm-like pattern in space (1).

Developing a system using the light scattering photometer may provide a technique to evaluate the dynamic changes observed in space from erythrocytes representative of various pathophysiological conditions and different animal species. A primary objective would be to determine the relationship of the functional organization and the spatial arrangement of the erythrocytes. Procedures for both ground based and space studies need to be developed for erythrocyte collection, preparation, and storage; incorparating the erythrocytes from storage into the light scattering photometer; measuring the erythrocyte angular changes and computer analyzing the data; and collecting, preparing, and storing the erythrocytes for histological evaluation. These developmental procedures will be

employed for both ground based studies and studies in the KC-135 research plane. The ultimate goal will be to prepare a system which could evaluate the dynamic changes for any macromolecule during future space shuttle missions and for the space station.

References

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